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Published in:
Mineralogical Magazine

DOI:
[10.1180/minmag.2013.077.5.18](https://doi.org/10.1180/minmag.2013.077.5.18)

Publication date:
2013

Document version
Publisher's PDF, also known as Version of record

Document license:
[Unspecified](#)

Citation for published version (APA):
Rodler, A., Frei, R., Gaucher, C., Vögelin, A. R., Ullmann, C. V., & Korte, C. (2013). Chromium isotope record of the Otavi Group, Namibia. *Mineralogical Magazine*, 77(5), 2075. <https://doi.org/10.1180/minmag.2013.077.5.18>

Chromium isotope record of the Otavi Group, Namibia

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Due to its redox-sensitivity, the chromium isotope system is an interesting paleoclimatic tracer particularly powerful in recording fluctuations of atmospheric oxygenation and continental weathering [1]. Here we seek to investigate detailed $\delta^{53}\text{Cr}$ records associated with intense climatic changes during Neoproterozoic glaciations.

We present a $\delta^{53}\text{Cr}$ record of late Neoproterozoic marine carbonates stretching from the Chuos (746±2Ma[2]) to the the Ghaub Fm (635.6±0.5Ma[3]), exposed in northern Namibia, covering shallow water sedimentation during the Cryogenian glaciations. The $\delta^{53}\text{Cr}$ stratigraphy was complemented with $\delta^{13}\text{C}_{\text{carb}}$ as well as major and trace element concentrations. The Chuos $\delta^{53}\text{Cr}$ signal is close to mantle inventory [4], but recovers rapidly to positive values after the glacial sequence, indicating a sufficiently oxygenated atmosphere. Prior to the Ghaub glaciation, $\delta^{53}\text{Cr}$ values are positively fractionated (+0.12±0.02‰) and correlate to $\delta^{13}\text{C}_{\text{carb}}$, while in post-Ghaub carbonates $\delta^{53}\text{Cr}$ values decrease to ~-0.08‰, similar to drops observed in post-Chuos sediments, and accompanied by increased Cr, Sc, and Ti concentrations. These $\delta^{53}\text{Cr}$ results suggest increased continental-derived detrital input as a consequence of enhanced weathering periods related to rapid climate change, elevated post-glacial $p\text{CO}_2$ [5], proximity to the continent and/or increased hydrothermally-derived Cr input.

The observed $\delta^{53}\text{Cr}$ fluctuations indicate sufficiently high atmospheric oxygen levels to oxidize and mobilize Cr during weathering processes on land prior and after the major Neoproterozoic glaciations. Increased weathering due to rapid post-glacial rise of $p\text{CO}_2$ render the $\delta^{53}\text{Cr}$ signal unfractionated, also potentially indicating the predominance of accumulated hydrothermally-derived Cr in the shallow seawater pool during the Ghaub aftermath.

[1] Frei *et al.* (2012) *Gondwana Research* **23**, 797–811. [2] Hoffman *et al.* (1996) *Communs Geol. Surv. Namibia* **11**, 47–52. [3] Hoffman *et al.* (2004) *Geology* **32**, 817–820. [4] Schoenberg *et al.* (2008) *Chemical Geology* **249**, 294–306. [5] Crowe *et al.* (2013) *EPSL* (in press).

A new experimental approach to silicic magma differentiation

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The separation of fluid and crystals from melt at diverse stages in the evolution of magmatic systems is inferred on the basis of thermomechanical modelling [1], geochemical relations of zoned silicic plutonic bodies [2] and phase equilibrium studies [3]. However, experimental tests dealing with magmatic differentiation of natural magmas at real pressures and temperatures are very scarce [4, 5].

In our laboratory experiments, gravity effects are separated from those imposed by thermal gradients, which simulate natural conditions of crystallization in a cooling magma chamber. Major and trace element distribution profiles result from the thermal gradient for water-bearing magma systems. The observed profiles are exclusively explained by diffusion in the liquid and boiling-assisted crystal-liquid separation, without invoking gravity crystal settling. These experiments confirm the key role of fluids in silicic magma differentiation and their implications on explosive volcanism and ore deposit generation.

[1] Huber *et al.* (2009) *EPSL* **283**, 38–47. [2] Bachmann & Bergantz (2004) *Journal of Petrology* **45**, 1565–1582. [3] Pichavant *et al.* (2002) *Geochimica et Cosmochimica Acta* **66**, 2193–2209. [4] Masotta *et al.* (2012) *Contributions to Mineralogy and Petrology* **163**. [5] Huang *et al.* (2009) *Geochimica et Cosmochimica Acta* **73**, 729–749.